

These are the basic skills we need to solve equations.

Elementary algebra

Class notes

The Addition and Multiplication Properties of Equality (section 2.2)

**Definition: Linear Equation:** an equation that *could be written* in the form  $ax + b = c$  where  $a$ ,  $b$ , and  $c$  are real numbers ( $a$  is said to be non-zero) and  $x$  is the variable.

expls:  $5x + 3 = 0$      $4x = 1$      $\frac{1}{2}x - 3 = 1$

$3x + 4x - 5 = 17 + 2x$      $x = -9$

counterexpls:  $\sqrt{4x + 6} = 3$      $4x^2 = 1$      $7x + 5$

only  $x$  terms;  
no  $x^2$ ,  $x^3$ , etc  
terms

equal sign

We will be *solving* these equations. What does that mean? How is that different from simplifying expressions?

We will change the equation to equivalent equations, step by step, until we get the variable isolated by itself on one side of the equation.

### Addition Property of Equality:

If  $a$ ,  $b$ , and  $c$  are real numbers, then  $a = b$  and  $a + c = b + c$  are equivalent equations.

You can add (or subtract) a number to both sides of an equation and the sides are still equal.

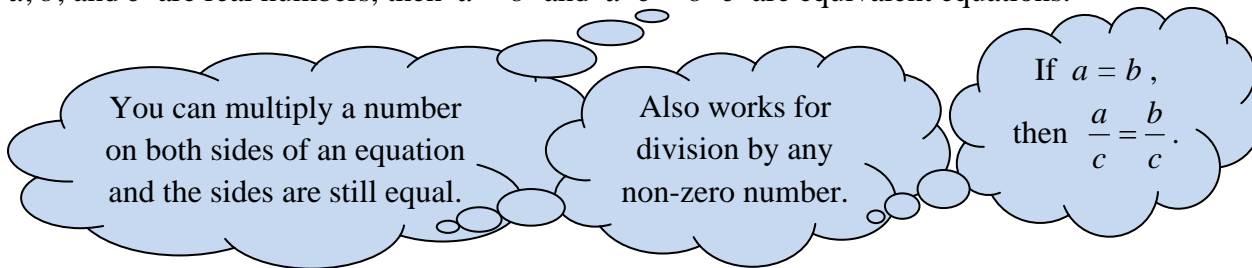
expl 1: Solve the following equation. Show the work explicitly to show how the addition property works. Check your answer.

$$y - 11 = 3$$

Notice how adding 11 to the left side gets rid of the "minus 11" and leaves the  $y$  alone.

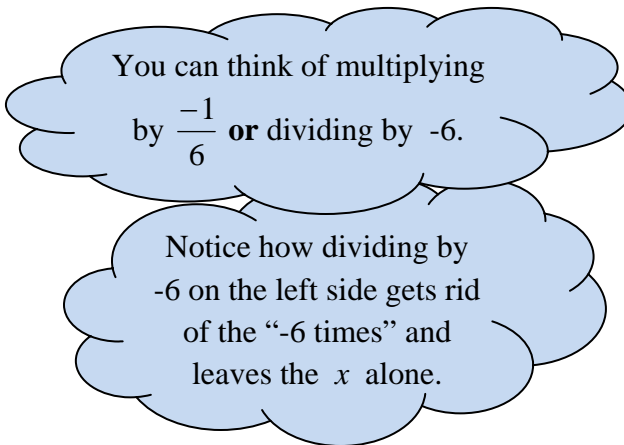
## Multiplication Property of Equality:

If  $a$ ,  $b$ , and  $c$  are real numbers, then  $a = b$  and  $a \cdot c = b \cdot c$  are equivalent equations.



expl 2: Solve the following equation. Show the work explicitly to show how the multiplication property works. Check your answer.

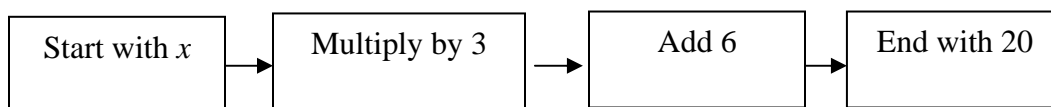
$$-6x = 42$$



## Worksheet: Solving Linear Equations:

This worksheet helps you understand why we perform the steps we do to solve an equation. It involves looking at an equation and thinking about what happened to the variable to get it into the equation (called a verbal model), and then simply undoing those steps. We concentrate on equations with one instance of the variable, but what we learn can be applied to more complicated equations. Solutions are also available.

For instance, let's say we want to solve the equation  $3x + 6 = 20$ . The verbal model that describes this equation is below.

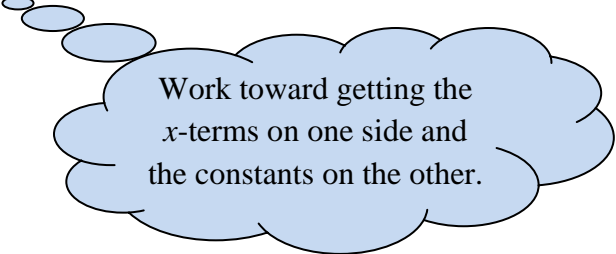


So if we undo these operations (in reverse order) we should be able to uncover the  $x$ . Remember we'll do these reverse operations to both sides of the equation. While we uncover the  $x$  on the left side, the solution will form on the right.

Again and again, we will use these properties to solve equations. The most important thing to keep in mind is that if you do something to one side of an equation, you must do that same thing to the other side.

expl 3: Solve the following equation. Show the work explicitly to show how the addition and multiplication properties are used. Check your answer.

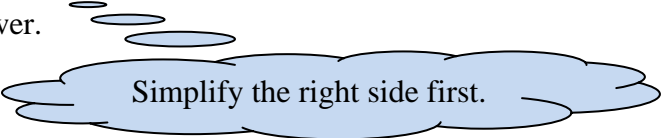
$$7x + 7.3 = 9x$$



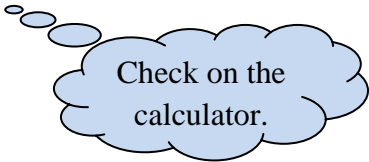
Work toward getting the  $x$ -terms on one side and the constants on the other.

expl 4: Solve the following equation. Show the work explicitly to show how the addition and multiplication properties are used. Check your answer.

$$27 = 4(3y + 2) - 4y + 3$$



Simplify the right side first.



Check on the calculator.

expl 5: Solve the following equation. Show the work explicitly to show how the addition and multiplication properties are used. Check your answer.

$$\frac{2}{3}r = -6$$

expl 6: Solve the following equation. Show the work explicitly to show how the addition and multiplication properties are used. Check your answer.

$$\frac{p}{4} = -5$$

expl 7: Solve the following equation. Show the work explicitly to show how the addition and multiplication properties are used. Check your answer.

$$5x - 4 + 3x = 2x + 5 + 2x$$

Simplify both sides individually first.

Then isolate the variable terms by using the addition property.

Then use the multiplication property to get  $x$  completely alone.

expl 8: If  $x$  is the first of three consecutive odd numbers, write their sum as an algebraic expression using  $x$ .

Write down an example of three consecutive odd numbers like 3, 5, 7.

How are the three numbers related?

What arithmetic would you do to get from 3 to 5 to 7?